Title: Shifting to Project-Based Learning in the Advanced Placement Context

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Paper Abstract

We harnessed a large-scale randomized controlled trial to investigate if and how experienced Advanced Placement (AP) Environmental Science and U.S. Government treatment teachers would shift their practice towards the Knowledge in Action project-based learning (PBL) approach. In any instructional context, shifting to project-based learning can be difficult for teachers and students. The AP curriculum framework breadth and examination focus may exacerbate the challenge. Under conditions of optimal support and compared to randomly-assigned, business-as-usual control teachers, treatment teachers shifted towards greater emphasis on deeper learning objectives, more student-centered pedagogy, more authenticity, and less lecture and explicit examination-preparation. Though the shift was challenging, students reported feeling prepared for the relevant AP examination, and over ninety percent of teachers recommended the approach.

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Shifting to Project-Based Learning in the Advanced Placement Context

Globalization and technological innovation compound the need for schools to prepare students for college, career, and citizenship in the 21st century. Students must learn deeply to develop the ability to think and communicate in sophisticated ways, demonstrate creativity and innovation, and transfer their skills, knowledge, and attitudes to new contexts. The traditional "transmission" model of instruction, in which teachers transmit knowledge to students through lectures and assigned readings, may be insufficient for supporting students' deeper learning (Gardner, 1999; Perkins, Jay, & Tishman, 1993; Schwartz & Fischer, 2006).

In contrast, through project-based learning (PBL), students actively engage in teacher- and student-posed learning challenges, working alone and in groups on complex tasks organized around central questions that lead to a final product, while teachers play a primarily facilitator role (Hmelo-Silver, 2004; Thomas, 2000). According to a large body of observational research, through PBL, students develop positive outcomes including thinking strategically, designing solutions to complex challenges (Walker and Leary, 2009), long-term retention, and skill development (Strobel & van Barneveld, 2009).

This implementation study, part of a randomized controlled trial examining the impact of a PBL curriculum in the Advanced Placement (AP) context, sought to determine if and how experienced AP U.S. Government and Environmental Science teachers would shift their curriculum and pedagogy towards PBL during their first year using the approach.

The Advanced Placement Context

The AP program began in 1955 as a means for academically advanced high school students to study college-level material while still in high school, with the opportunity to earn college credit and/or placement in higher-level college courses. The program has grown exponentially over the last two decades such that by 2017, nearly forty percent (1,174,554 out of 3,115,528) of graduating 12th graders took at least one exam (College Board, 2018). Equity has been one of the College Board's core growth objectives, which they have realized with, "impressive gains in access" (Kolluri, 2018, 1) among low-income (College Board, 2014) and Latinx students (College Board, 2013; College Board, 2018). However, during this period of AP program growth there has been a corresponding decrease in pass rates.[i] This decrease, particularly among African-American and Latinx students with pass rates—calculated by dividing the total number of exams scored as three or higher by the total number of exams taken—of 30 and 42 percent respectively, in comparison to 64 and 70 percent for white and Asian students respectively (College Board, 2018b), indicate that AP courses are not meeting the needs of all enrolled students.

Declining passing rates, in concert with the increasing amounts of information courses have been required to cover, prompted improvements of AP course designs and exams. Originally called to action by the National Research Council's (2002) recommendations for AP courses to better reflect how people learn and to improve the balance between breadth and depth, the College Board now is committed to redesigning courses. Currently, 20 of the 38 AP courses have been redesigned, including AP U.S. Government but not AP Environmental Science. Key features of the redesign include:

- A greater emphasis on discipline-specific inquiry, reasoning, and communication skills
- Rigorous, research-based curricula, modeled on introductory college courses, that strike a balance between breadth of content coverage and depth of understanding
- Standards informed by recommendations of national disciplinary organizations, results of curriculum studies, and leading pedagogical and measurement practice
- Detailed curriculum frameworks, which tie the discipline-specific concepts, themes, and skills to a set of key learning objectives and emphasize conceptual understanding
- Exam questions designed to elicit evidence of student achievement for each learning objective (College Board, 2015)

Execution and implementation of the key redesign features in AP curriculum and instruction would lead, arguably, to improvements in participating students' deeper learning development, with potential spillover to other courses, teachers, and students. Such changes might also lead to improving instruction in schools serving high proportions of low-income students, those who would benefit the most from improved AP instruction.

Challenges to shifting instructional approaches in the Advanced Placement setting

Realization of the College Board's objectives faces two main challenges. First, educational systems tend to resist change (Tyack & Cuban, 1995), particularly concerning shifts away from traditional forms of instruction such as transmission-based models. AP is a particularly challenging setting for such an instructional change (e.g. Dole, Bloom, and Kowalske, 2016). AP teachers may be especially inclined to follow the transmission model because of prevailing AP culture that emphasizes breadth of coverage over depth of learning, and examination preparation over any other objective (Parker, Lo, Yeo, A, Valencia, Nguyen, Abbott, Nolen, Bransford, & Vye, 2013). Also, both students new to AP and those who previously took traditional AP classes can be anxious about whether they will have sufficient examination preparation (Barron & Darling-Hammond, 2008; Parker, Mosberg, Bransford, Vye, Wilderson, & Abbott, 2011; Parker et al, 2013).

The Knowledge in Action Intervention

Knowledge in Action (KIA) is a PBL approach to teaching AP designed to support students' deeper learning of content and skills. The University of Washington researchers and local teachers who collaboratively developed the KIA curriculum envisioned a means to realize the potential yet under-realized impact AP courses could have on deeper learning for all students (Parker et al, 2011). KIA employs transmission instruction, but in a way intended to maximize its benefits. Five design principles substantiate the curriculum, for example, the "engagement first" (Schwartz & Bransford, 1998) principle—based on Schwartz and Bransford's (1998) research on instructional sequence—is that initiating learning about a topic through project work will prime students' interest and create a context for learning content through reading or lecture. Other design principles include: projects are central to the curriculum rather than supplementary; curriculum loops "quasi-repetitively" over content and skills throughout the course of the year; teachers are co-designers, adapting the curriculum in response to their students' needs and their own; and the approach is scalable.

The developers designed the KIA curriculum to cover an entire subject-specific AP curriculum

framework through five project units taught over the course of an academic year. KIA curriculum and instruction materials are available through an online portal hosted by Lucas Education Research. Intensive and ongoing in-person professional development (PD), provided by the Buck Institute for Education during the study, included a four-day summer institute, full-day in-person coaching four times throughout the year, virtual coaching, and on-demand support throughout the year. Teachers also had access to a teacher community developed through the portal and PD. KIA curriculum and instructional materials are currently available for AP U.S. Government (APGOV), AP Environmental Science (APES), and AP Physics courses; this study addressed the first two.

Research Questions

The research questions we addressed in this study were:

- Did experienced AP U.S. Government and Environmental Science teachers in treatment schools, relative to similar teachers in control schools, shift their curriculum and pedagogy towards a PBL approach during their first year participating in the KIA program? If so, how?
- How did teachers and their students in treatment schools describe their experiences with the KIA approach?

Study Design

We first recruited districts to participate in this study, then teachers from within those districts. Each teacher decided whether s/he wanted to use the KIA curriculum to teach their APGOV or APES course, and consequently, participate in the research study. Though principals' roles varied by district, for the most part, they had minimal involvement in teachers' decision whether or not to enroll. In late spring and summer 2016, we randomly assigned schools to treatment and control conditions. All teachers and their students within a school received the same condition assignment.

Data

To address our research questions, we collected interview, survey, and/or instruction log data from students, teachers, school leaders, and district staff across five participating school districts, as well as administrative records for participating teachers and their students. We also interviewed teachers' professional development coaches. Appendix A presents each of our implementation-related primary data sources in rough chronological order as administered.

To describe schools, in addition to district-provided administrative records, we collected school-level data from the National Center for Education Statistics and state and district websites. We also used teacher survey responses,[ii] and called some schools to fill in missing bell schedule information. Across the 68 schools in the base sample, the number for which we have school structure data varies by item between 59-68 due to teacher non-response to some items.

To describe the teacher sample, we draw from administrative records, supplementing with survey responses and follow-up inquiries as necessary.[iii]

We describe students using administrative records collected from school districts.

Sample

We base reported results on data collected from teachers, and their students, school leaders, and coaches during the 2016-17 school year. Across our five participating districts—all large and predominantly urban— spread geographically across the United States, our base sample included 3,645 students across 68 schools and their 74 teachers. For the present implementation study, we only included responses from teachers who complied with their assigned treatment status—31 of 35 treatment teachers and all 39 control teachers—and their students, school leaders, and coaches. Treatment complier teachers were the teachers assigned to the treatment status who participated in at least one day of KIA PD and/or accessed KIA curriculum via the online portal.

Schools

The schools in our sample served primarily economically disadvantaged students such that 64 percent of students enrolled at the schools were eligible to receive free or reduced-price lunch and 71 percent were classified as Title 1 (NCES, 2015).

Several aspects of school structure and culture may have facilitated or hindered implementation of the KIA curriculum. For instance, whether or not a school required students within a given APGOV or APES course to take the associated AP examination may have influenced decisions about curriculum and instruction, relative prioritization of knowledge and skill development, and/or expectations for students. Across the 64 schools for which we had survey responses, 81 percent required all or most students who enrolled in an AP course to take the AP exam associated with that course, though there could be exceptions. The 12 schools in the analytic sample that did not require students to take the AP exam for the associated course were located in three of the five participating districts, with eight of the 12 schools in one district.

Whether or not teachers APGOV or APES courses had block or modified block schedules, compared to a traditional schedule, dictated the amount of uninterrupted instructional time teachers had with their students—varying from 40 to over 100 minutes. According to teacher reports, 59 percent of the schools used block or modified block scheduling.

Other school structures can be facilitators or hindrances to PBL instruction as well, such as service learning requirements that supersede course-level requirements, and/or teachers' use of team-teaching techniques, interdisciplinary curriculum, or portfolio assessments. Across the 59-60 schools for which we had school structure data, depending on the structure approximately half (32 schools, 53 percent) mandated that students participate in community activities. Team teaching was also common, present in 27 of 60 schools (45 percent). Interdisciplinary curriculum and use of portfolio assessments was less common across all schools (present in approximately one-quarter of participating schools).

Teachers

Of the 74 teachers in our base sample, 70 "complied" with their treatment status. Of the 70 complier teachers, 54 (27 treatment and 27 control) completed both pre- and post-surveys[iv] and 61 (27 treatment and 34 control) completed instruction logs. We also draw from interviews with a sub-sample of 21 teachers (14 treatment and seven control) and their students and school leaders, as well as all ten coaches.

The teachers in our sample were predominantly female (62 percent) and white (80 percent of the

54 for whom race was available). They were experienced, such that more than two-thirds of the 55 for whom experience information was available had ten or more years of experience, and 75 percent of the 42 teachers for whom degree information was known held at least a Master's degree. At the beginning of the year, the 63 teachers who completed the pre-survey reported feeling more prepared in general instructional strategies than inquiry-based approaches, on average. Teachers' APGOV or APES course section included an average of 29 students.

Students

Our student sample was roughly half (54 percent) enrolled in APES courses and half (46 percent) in APGOV. Nearly ninety percent were in eleventh or twelfth grade, with 61 percent in twelfth grade, followed by 25 percent in eleventh grade. Tenth and ninth graders composed 13 percent of the sample. Half of the sample (49 percent) took at least one AP examination in May 2016, the year prior to data collection for the present study; of those students who took at least one examination, on average students took one exam.

Fifty percent of the KIA student sample was composed of students from traditionally disadvantaged racial groups (i.e. Non-Asian and Non-White: Black, Latinx, Native American/Islander). In comparison, one-third of the 2017 AP test-taking samples in those two courses were from similar racial/ethnic groups (College Board, 2018). Compared to the national population of AP examination takers, the KIA student sample also had a higher proportion of low-income students as defined by eligibility to receive free or reduced-price lunch. The KIA sample was 43 percent low-income compared to 27 percent among AP test-takers nationwide (Godrey, Wyatt, & Beard, 2016).

Students from 50 classrooms (22 treatment, 28 control) completed student surveys.

Analytic Methods

To examine whether the KIA intervention changed teacher practice such that treatment classrooms were more consistent with KIA's PBL approach compared to control classrooms, we collected and analyzed all data shown in Appendix A.

We compared treatment and control teachers' beginning- and end-of-year responses to survey questions[v] and students' end-of-year survey responses. We also examined teacher responses to 10 consecutive days of instruction logs, administered in March and early April 2017—prior to the last weeks of the semester leading up to the May 2017 AP examinations.[vi] To summarize teacher instruction and make comparisons between treatment and control teachers' daily activities, we collapsed observations within teacher to represent the percent of instructional days on which the teacher reported an activity. For yes/no response option questions, collapsing was straightforward and resulted in the percent of instructional days for which a teacher reported an activity. We then compared the average percentage of days reported "yes" on a given item between treatment and control groups.

For questions with a frequency scale response, we calculated two summary statistics per teacher: 1) the percent of days on which the teacher reported any of the activity and 2) an average for the extent to which the activity was implemented on a scale of 1 to 3 (limited, moderate, great extent). We then summarized these teacher level averages by looking across all treatment teachers and all control teachers and reporting 1) the mean percentage of days (i.e. frequency of use), or 2) the standardized mean difference of the extent to which the activity was implemented (i.e. extent of use). We include the

instrument log instrument in Appendix B.

For survey and instruction logs, we calculated mean differences between treatment and control groups and then standardized differences using Glass's Delta. Harnessing our randomized controlled trial study design and consistent with our use of the word "shift" throughout this paper, we make the assumption that treatment teachers were just like control teachers in the year prior and thus use the control group standard deviation in the standardized mean difference calculation.

For the student survey, to weight each classroom evenly rather than each student, we aggregated students within the same classroom to create classroom-level means prior to calculating mean differences.

We did not use inference methods when examining differences between treatment and control teachers' instruction log or survey responses for several reasons, including the inflated risk of a Type I error given the high number of comparisons, and the ordinal nature of response scales which makes interpretation of inferential models complex. Rather, to identify meaningful and substantive differences, following the U.S. Department of Education Institute of Education Sciences' What Works Clearinghouse we define a meaningful standardized mean difference as one that is larger than 0.25 standard deviations (SD). We also point out differences of smaller magnitude when they are part of a measured pattern describing an instructional practice trend across items or questions.

For qualitative data sources (i.e. beginning-of-year interviews with district staff, beginning- and end-of-year individual interviews with students and teachers, end-of-year student group interviews, end-of-year school leader interviews, and mid- and end-of-year coach interviews) we generated code frequencies to identify which domains and ideas were relatively more common and which rarely occurred.

To attenuate any bias incurred through research participants' knowledge of treatment status, we triangulated teachers' survey and log self-reports with student and coach reports of classroom activities. We used qualitative data to explain quantitative results and to provide context, exemplars, and divergent or disconfirming evidence.

Results

As expected, control teachers in their business-as-usual classrooms used some curriculum and instructional practices that were consistent with the KIA approach, as did treatment teachers prior to their involvement with KIA. As such, we did not expect to find differences between treatment and control teachers on every domain measured, though it was realistic to expect to see more "KIA-like practices" taking place in treatment classes than in control classrooms. We found that relative to control, treatment teachers used student-centered, KIA-aligned practices more frequently and to a greater extent, with treatment teachers sustaining their KIA use throughout the year. Teachers and students perceived the transition to KIA as both challenging and beneficial. Students reported feeling prepared for the relevant AP examination, and teachers recommended KIA to others, and plan to continue using the approach.

Implementation of Knowledge in Action curriculum and instructional practices

We found that compared to randomly-assigned control teachers—who were using business-as usual

AP curriculum—treatment teachers' learning objectives for students were more focused on deeper learning. Treatment teachers also used student-centered pedagogy more frequently and to a greater extent, and less frequently lectured and used explicit examination-preparation instructional activities.

Treatment teachers' learning objectives for students were more focused on deeper learning.

When we interviewed teachers at the beginning of the year, we asked about their most important learning objectives for AP students. The objectives most commonly described as most important – in both treatment and control groups – related to civic engagement, particularly community activism, and environmental awareness and activism. The following is one example from a treatment APGOV teacher at the beginning of the year:

> "I want students to fully understand the important role of civic education in general. I think that too often, and not just for students, but as Americans in general, government seems to be archaic, far from us, and policies and decisions that are made are made on our behalf. I wanted students to be active citizens in our democracy. The neighborhood I teach in, I would say the civic engagement is very low in general. I think that's unfortunate, and I understand why – because the majority of my students come from lower income families, from situations that aren't necessarily ideal, and oftentimes I think that to be civically engaged, there's a privilege associated with that. I want to convince our students that being civically engaged isn't just for the dominant majority group, isn't just for the wealthy, that they have a stake in their government and the decisions that are made for them as well."

Also at the beginning of the year, a control APES teacher described a similar sentiment about civic engagement learning objectives, in this case enmeshed with critical thinking skills,

> "I want the students to have a thorough understanding of the content, and they don't have to memorize – I don't care about the memorization of facts. I want them to understand what, why, and how this stuff is happening. What are the issues, how are they impacting humans or environment or economic issues, and what have we done to correct them… I want them thinking critically, I want them analyzing and evaluating … and then coming up with the whole 'here's what has to happen, here's why it needs to happen'… solution."

By mid-spring 2017, compared to control, treatment teachers reported over the course of consecutive instruction log days that their instruction more frequently focused on deeper learning objectives. As we show in Table 1 below, development of students' creativity was the area of greatest difference, with treatment teachers reporting focus on this objective on 81 percent of instruction log days compared to 67 percent of instruction log days across control teachers. Other objectives with greater treatment teacher frequency of focus included development of students' interpersonal skill, college and career awareness, problem-solving skills, and civic engagement.[vii]

Table 1. Difference in the percent of days on which treatment and control teachers reported focusing on various student learning objectives over consecutive instruction log days in spring 2017.

	Control (%)	Treatment (%)	Difference (%)
Develop creativity	67.0	81.1	14.1
Develop interpersonal skills	73.0	81.6	8.6
Develop college/career awareness	48.9	57.3	8.4
Develop problem-solving skills	83.1	91.3	8.2
Develop civic engagement	73.5	79.9	6.4
Develop intrapersonal skills	79.5	83.2	3.7
Develop engagement/motivation	90.1	93.5	3.4
Develop critical thinking skills	95.3	97.1	1.8
Develop content knowledge	97.8	97.5	-0.3
Develop scientific literacy* (only APES teachers)	95.9	94.5	-1.4
Develop AP exam-taking skills	82.2	80.4	-1.8

Information about the percentage of days during which a teacher reported focusing on a given learning objective is one lens with which to examine classrooms, with data on the *extent* to which teachers focused on a given learning objective providing another lens. Not only did treatment teachers report focusing on students' thinking skills on a higher percentage of days, but they also reported focusing on these skills to a greater extent than comparison teachers on the days they focused on those skills.

Figure 1 shows the mean difference between treatment and control teachers' instruction log reports of the extent to which they emphasized various learning objectives on the days on which they reported having emphasized them at all. The grey vertical line demarcates a mean difference of zero. Mean differences to the right of zero indicate the treatment group average was higher than the control group, and vice-versa. Red dashed lines show positive and negative 0.25 SDs. We use this figure format several times throughout this paper.

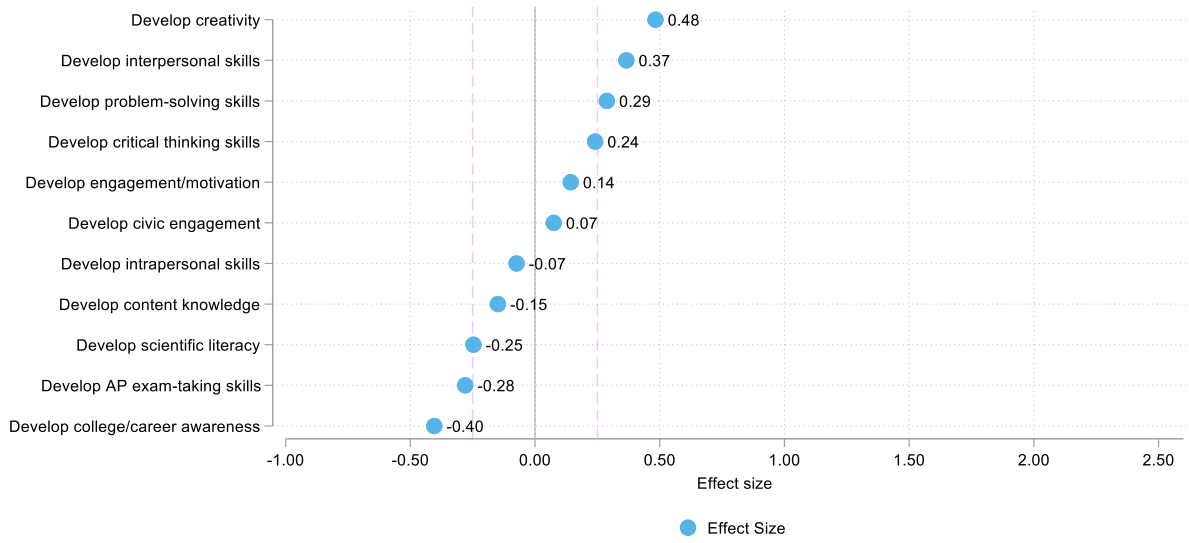

Figure 1: Standardized mean differences between treatment and control teachers' reported extent to

which instruction focused on various student learning objectives over consecutive instruction log days in spring 2017.

The figure shows standardized mean differences of 0.48, 0.37, and 0.29 SDs between the extent to which treatment and control teachers reported focusing on developing creativity, interpersonal skills, and problem-solving skills respectively, in mid-spring 2017 on the days in which they reported emphasizing them at all. That is, treatment group teachers' average rating of the extent to which they emphasized developing creativity was 0.48 SDs higher than the average rating of emphasizing developing creativity among control group teachers, and similarly for developing interpersonal and problem-solving skills, with differences of 0.37 and 0.29 SDs. The difference of 0.24 SDs in average ratings of developing critical thinking skills nearly met the meaningful threshold. On the other hand, though treatment and control teachers reported developing students' AP exam-taking skills on essentially the same percentage of days (as we show in Table 1), on those days, treatment teachers focused on this skill to a lesser extent than control teachers by -0.28 SDs.

Though treatment teachers reported less focus on college and career awareness during instruction log days (-0.4 SDs), a coach pointed out that preparation for college includes specific learning objectives that KIA teachers reported prioritizing including, "collaboration with others… negotiation… accountability to the teacher and also to their group and their teammates." The coach also explained that the kind of "memo or brief" writing that students do in KIA, as opposed to, "free response questions" writing in more traditional AP classes, makes them go "through the analytical process to think through an argument and support it with evidence."

Treatment teachers used student-centered instructional practices more frequently

In mid-spring 2017, treatment and control teachers reported that students were actively engaged with course learning on the same percentage of instruction log days (87 percent for both groups). However, as we show in Figure 2, when teachers described the distribution of their class time in the end-of-year survey, treatment teachers reported spending the most time facilitating group work (41 percent of the time) followed by delivering large group instruction (25 percent of the time). In contrast, control teachers reported delivering large group instruction the most often (35 percent of the time) followed by facilitating group work (29 percent of the time), an average of 12 percentage points lower than treatment teachers. These responses describe a fundamental difference between how treatment and control teachers balanced instructional time across transmission and student-centered instructional practices.

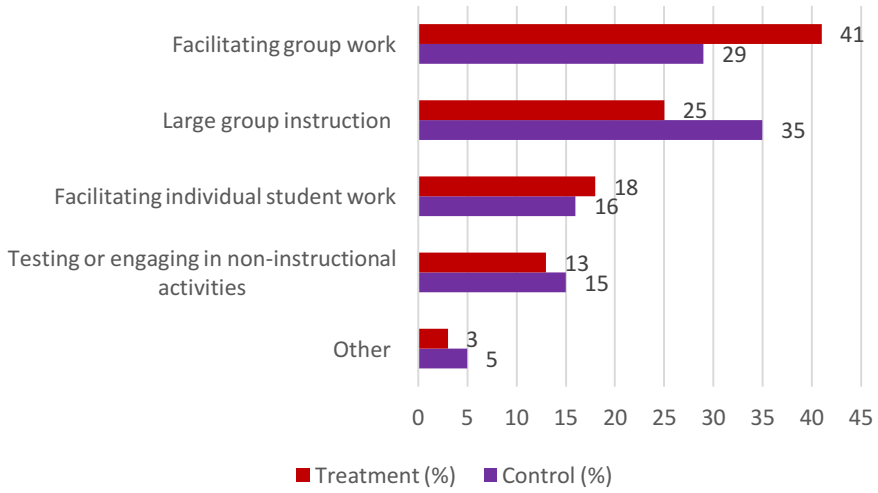

Figure 2: Treatment and control teachers' reported proportions of class time spent facilitating group work and delivering large group instruction at the end of the year.

Drilling down on frequency of time use, in mid-spring 2017, treatment teachers reported spending more time using student-centered instructional practices compared to control teachers, including more student presentations (36 versus 28 percent of instruction log days), simulations (44 versus 41 percent), and long-term projects (60 versus 45 percent). Student reports of time use aligned with teacher reports. On end-of-year surveys, treatment teachers and students also reported more frequent use of performance-based assessments compared to control teachers and students (by 0.72 and 0.63 SDs, respectively).

Also in mid-spring 2017, KIA teachers, compared to control teachers, reported more heavily emphasizing group work (by more than half a standard deviation), one-on-one instruction, culminating project presentation, teams presenting materials, teachers modeling skills for students, and simulations/debates, all with standardized mean differences of greater than 0.25 SDs. KIA teachers less heavily emphasized independent student work, whole group instruction and teacher lecturing on the days those activities were used. Figure 3 shows the standardized mean differences between treatment and control teachers' averaged instruction log reports of *the extent to which* KIA teachers reported using KIA-aligned practices on the days they were using them.

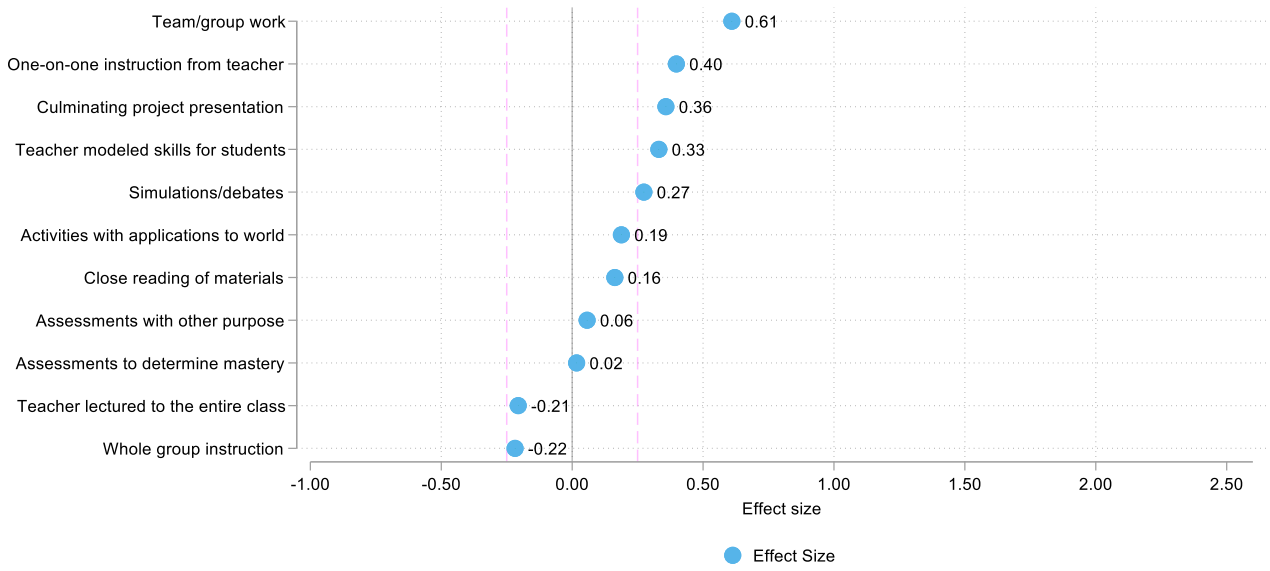

Figure 3: Mean difference between treatment and control teachers' reported extent to which instruction included various activities over consecutive instruction log days in spring 2017.

On the end-of-year teacher survey, the most pronounced differences in use of classroom instructional time was that treatment teachers reported less frequently lecturing to the whole class (-0.4 SDs) and engaging in less AP test prep activities (-0.4 SDs). Students' perspectives as reported on the end-of-year survey corroborated teachers' reports albeit with lesser magnitude, reporting less AP exam preparation (-0.18 SDs) and lecturing (-0.13 SDs) compared to students in control classrooms. Despite these differences in the types and distribution of classroom instructional time, students in treatment teachers' classrooms did not report feeling less prepared for the relevant AP examinations after they took them, as we describe in greater detail later in this paper.

In terms of out-of-class assignments, in mid-spring 2017, treatment and control teachers both reported assigning work to complete outside of class on a similar percentage of days, sixty-four percent. However, the nature of what teachers asked students to do outside of class was meaningfully different: treatment teachers assigned ongoing project work 65 percent of the time, while control teachers assigned ongoing project work 35 percent of the time.[viii] The proportions were reversed for quick turnaround work with control teachers assigning quick turnaround work 65 percent of the time and treatment teachers doing so 35 percent of the time (Figure 4) These results were large with a difference of 30 percentage points and indicate a fundamental change in the type of homework participating teachers assigned.

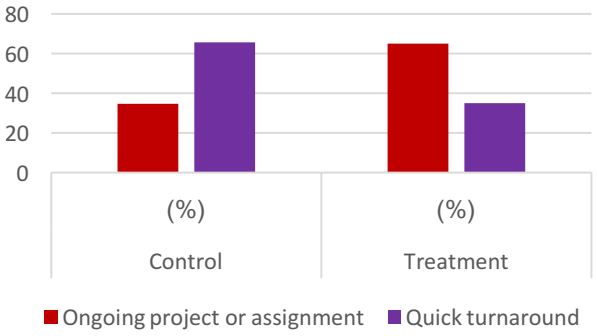

Figure 4: Differences in percent of days on which treatment and control teachers assigned outside of class work, ongoing projects, and quick turnaround work over consecutive instruction log days in spring 2017.

Comparisons between students' end-of-year survey-based reflections on teacher behaviors did not indicate as many pronounced differences between treatment and control classrooms, though the pattern of student responses indicated more student-centered activities, and less lecture and AP examination preparation. The most pronounced differences, as we show in Figure 5, were that compared to students in control classrooms, students in treatment teachers' classrooms reported, to a greater extent, working on projects that take several weeks to complete (0.48 SDs), participating in role play and/or simulations (0.44 SDs), and conducting oral presentations (0.28 SDs).

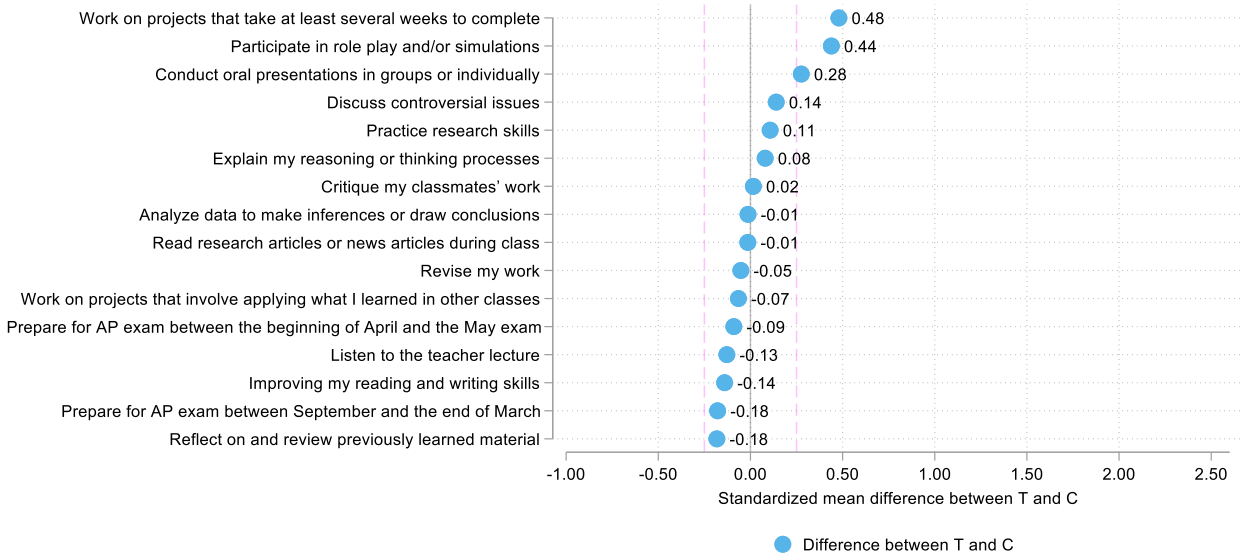

Figure 5: Standardized mean differences between students' end-of year reports on extent of engagement in inquiry- and transmission-based instructional activities in treatment compared to control classrooms.

Together, results about teachers' classroom-based instructional activities as reported by both teachers (frequency and extent used) and students, in mid-spring and at the end of the year, demonstrate that KIA teacher classrooms looked different from control teachers' classrooms. We elaborate below on teachers' and students' experiences to acclimatizing to this shift.

Acclimatization to student-centered instruction

According to concurring end-of-year interview reports from treatment teachers, students, and coaches, acclimating to KIA's student-centered approach was one of the most prominent challenges for treatment teachers and students to navigate. Key to the KIA approach, group work on projects presented challenges for teachers and students, though students also found group work and projects to be beneficial and enjoyable. The rate at which teachers and students progressed through the KIA curriculum, or pacing, felt difficult for both.

Teachers' felt the shift towards student-centered instruction was drastic yet they persisted with KIA throughout the year

The shift from their prior AP experience to the KIA approach felt like a major change for both teachers and their students. Describing what a juggling act the transition could be, a treatment teacher described how "you would go back to what you know [as a teacher], usually just for time constraints." Some treatment teachers felt, "I'm going to have to [integrate KIA] with what I know, just to make sure my kids are getting what they need."

Yet treatment teachers' interview reflections on shifting to the KIA approach indicated that though the transition felt difficult, it was also positive. One treatment teacher explained the extent to which KIA transformed his/her classroom:

> "When I first volunteered to attend the program I figured, 'Oh, I'll take away one thing and that will be something I can plug in somewhere in what I normally have been doing over the last few years.' I had no idea of the scope and how much it would impact the classroom and, I guess, how much it [affects] students. That was a huge piece of it because I thought I was going to get an activity and I'd be happy with that – something new. But it was definitely changing the classroom functioning, atmosphere, planning, everything – in a positive way, though, I think."

Indeed, treatment teachers sustained their use of the KIA approach through the year. On the end-of-year survey, all treatment teachers in our teacher survey sample (54 of 74 participating teachers) reported that they followed KIA project units throughout the year. Nearly ninety percent taught using at least four of five units, with the five units encompassing the entire year-long course. More than half of treatment teachers (52 percent) taught all five units. None taught less than three. Treatment teachers also reported using KIA curriculum on 82 percent of the days in which they completed instruction logs in mid-spring 2017.

Students felt they had to teach themselves content and skills and wanted more guidance from teachers

Teacher, coach, and student interview data aligned regarding students' experiences with the student-centered approach: finding a successful balance between student-centered instruction—including projects and group work—and business-as-usual transmission instructional approaches felt difficult.

During beginning-of-year interviews, treatment teachers anticipated the challenge of getting their students to "buy in" to the AP-level work, including the shift from being "spoon fed" information to more of an independent approach to learning. By the end-of-year interviews, treatment teachers talked even more about students' resistance and pushback. As one treatment teacher explained, the student-

centeredness of KIA required a fundamental and difficult "shift in mindset" for students.

From the perspective of most interviewed students in treatment teachers' classrooms, their struggle as described at the end of the year was the feeling that they had to teach themselves content and skills, yet they wanted more guidance from their teachers. In one group interview, students discussed how they "didn't really get anything" from their teacher:

> Participant: "We basically taught ourselves this course, the whole thing. We didn't really get anything from the teacher."
>
> Participant: "I mean we did get a small portion of [him/her] helping and all that, but mainly it was just us doing the work and trying to learn it. Some students really don't learn like that. If you don't teach us at all, we're not going to learn."

One treatment teacher described how his/her students reflected on this challenge after the first project cycle, and how it helped the teacher finesse his/her balance of direct transmission and student-centered activities:

> "Many students felt, 'I needed more from you. I needed you to help me learn this, and I need you to help me learn this.' That helped me realize I need to be explicit with these certain things."

While attempts to balance student-centered activities with more direct transmission resulted in some students feeling bored with lectures and notetaking, pushback came more so from students who were the most comfortable with the traditional transmission instructional approaches. As one coach explained,

> "The feeling that I get from a lot of these teachers is they are getting some pushback from kids. A lot of that is this is new …traditionally academically successful kids are being asked to do something that's not comfortable when they've been always really good at school and they understood the rules of school… It sounds like they've all had students go to counselors and say, 'I don't think PBL is for me.'"

Parker et al (2011) described this type of student pushback to the student-centeredness of the KIA approach as "the two worlds" challenge. Some students become familiar and successful at learning to prepare for and take AP examinations through the transmission method of instruction and find the shift to the student-centered KIA approach to be uncomfortable; they worry that their recipe for success may no longer work. One student interviewed for the present study summarized this perspective, explaining, "I wish that sometimes in class she would just stop with the projects, just go with the traditional class group setting, just teaching us like a regular class would." Students with high psychological need for cognitive closure—firm and unambiguous answers to questions—might be particularly uncomfortable with a PBL approach, even if they are performing quite well (Perkins & Ritchart, 2004).

Despite the challenge, however, as we describe later in this paper, both teachers and students perceived important benefits of KIA for students in the areas of deeper learning, civic engagement, and feelings of preparedness for success on the relevant AP examination.

Treatment teachers found grouping students and distributing work equally within groups challenging

In end-of-year interviews, KIA teachers most frequently described two features of successful groupwork on projects that were difficult to implement: 1) effectively grouping students, and 2) ensuring that all group members participated and shared an equal distribution of the work. While teachers described different strategies for tackling these challenges, they also explained that group work success depended on students' efforts or lack thereof. One APGOV KIA teacher explain how s/he changed grouping strategies throughout the year:

> "At the beginning of the year, you don't know and you put them in groups. Some of the groups were good, others not so good. Well, by the end of the year I know who the slackers are, and I put them all together. In one class, the slackers rose to the occasion; in the other class, they were slackers. So, their grade reflected that, too, because their presentation was horrible… They didn't want to work together, 'Gee, because all year you've been pulled along by the other groups?' That was very enlightening too. Again, some of the groups were just – the comments were outstanding about how prepared they were. They answered every question. Their visuals were good. They'll rise to what they're doing."

Another teacher explained how groupwork can help meet the needs of diverse learners, yet "stronger personalities" can still "take over":

> "I think sometimes what doesn't work as well is when you have students of vastly different ability levels. I had kind of your traditional AP students, who are high-flying, self-motivated students, and I had some students who… weren't necessarily really, really academically strong students. And so sometimes those students could get a little bit intimidated by some of the higher fliers. They would feel like, 'Oh, well what he said was just so smart, and look at the big words he's using, and he saw things I never saw,' and it could cause some of the other folks to withdraw. I had to be really careful to make sure that they felt supported and that their contribution was just as important… I think working in a small group can help that situation if they're feeling like, 'Okay, everybody in here's smarter than I am.' Rather than the whole class, [they're] working with this group. But it can be a little bit easy for your stronger personalities to take over, or people who are like, 'I have to get the A; therefore, I will do this, and you will just sit back and let me do it.'"

As the preceding excerpts illustrate, treatment teachers most commonly mentioned varying student grouping combinations and assigning specific roles to group members as effective means of facilitating group work.

Students in treatment classrooms enjoyed groupwork and felt it helped them learn to communicate and collaborate with peers

Though students in two KIA group interviews talked about groupwork challenges similar to those KIA teachers mentioned (e.g., the challenge of equally distributing contributions), overall, students' perspectives on groupwork were predominantly positive. In response to the open-ended end-of-year survey question about what they enjoyed most about their class, group work was one of the most

common responses. One student "had a really great time working together as a group to achieve different goals" and recognized that "[teaching] other classmates helped us to learn the topic more easily." Another stated "the thing I like most in this class is that we were given the opportunity to work in group many times and learn different skills from others."

Students also frequently reported that group work helped them learn to communicate and collaborate with their peers, "getting to hear their opinions," "learning together and having that kind of communication," which added to their learning experience. One student stated this "helped me to stay focused and enjoy the class even more."

Students' open-ended end-of-year survey responses also sometimes compared KIA group work to the work they do in other classes explaining, "my other classes mainly [were] independent work, so it felt good to work with other students," and, "I've never had a class that is so group heavy before and I enjoyed working with that style of learning." One student indicated that the group work, "helped make the class a lot less stressful."

Echoing many of the statements from the open-ended survey data, student interview data also painted a positive picture of students' groupwork experiences. Individual KIA student interview participants and participants in nearly two-thirds of the KIA group interviews talked about group work being enjoyable and helping them to learn. For example, one APGOV student provided more details about how group work helped improve communication and collaboration skills over the course of the year:

> "I think it has helped improve my collaborating skills in working with other students. That wasn't really something that I enjoyed and was good at, necessarily, but definitely now, I have—I'm a lot better at collaborating. Definitely research skills and writing, but mainly the whole collaboration aspect since we did so many projects and worked in groups all the time, you know, I think me being able to communicate with other students definitely got better as the year went on."

Realizing the benefits of group work as the year went on was a common theme among KIA teachers and students, and it is clear that it was enjoyable and enriching for students albeit challenging to implement successfully all of the time. In an APGOV group interview, one student made this conclusion about group work:

> "I mean even though I complained about that, it was kind of enjoy – like I kind of enjoyed working in groups and doing projects with other people and getting to interact with other people, so I liked it in that sense but at the same time I just wish we had a little more time to be able to complete certain things."

The sentiment of the preceding quote connects the advantages and appeal of group work with the challenges of implementing KIA at an appropriate pace that allows students to complete and reflect on their work. It represents a wider duality or tension that connects several of the topics discussed in this paper: teachers and students perceived KIA as challenging and tough to implement at the same time as being beneficial and helpful.

Pacing challenges were intrinsic to the first year with a new curriculum and also specific to KIA

Pacing refers to the rate at which teachers and students progress through a given curriculum. Teachers', students', and coaches' end-of-year feedback about KIA pacing fell into two categories. The first related to teachers' learning curve for adjusting to appropriate pacing, which is generally intrinsic to the first year with any new curriculum and implies a particularly heavy workload for teachers in the first year. The second was teachers' and students' perception that the KIA curriculum included too many activities with insufficient time built in for reflection and review. In combination, the two-fold pacing challenges were the most pronounced of all challenges discussed by KIA teachers in their end-of-year interviews. One teacher described this challenge:

> "There's a lot of material within each project that I think could be trimmed. Maybe they're just providing a wealth of resources to pick and choose from but the way it's written, it's like, 'You should do this, and then this, and then this, and then this.' Well, we did all that and our first two projects took five months or something like that. And I think when it tells you – they tell you that this should take 15, or this should take 45 minutes. I had to multiply that by two for each – for all the times. It always took twice as long as it said it was going to take. Once I realized what was happening it was late in the year. I was kind of frustrated with the rate and I think the kids, too. I think the projects were just too long. I think they should be just trimmed down. Because at the end, there was fatigue from the students."

A coach who largely thought the KIA curriculum was "pretty solid" concurred, sharing the perspective that teachers, "have a hard time getting through the curriculum, if [they] want to get through all the project cycles."

Most interviewed KIA teachers expressed the feeling that using KIA as a new curriculum for the first time was time-intensive and involved a heavy workload for the teachers themselves. When asked about challenges faced teaching KIA for the first time, one APES teacher stated,

> "Time was a challenge. Even though they provide you with a sense of how long it would take for the lesson, often times it did take longer than that because I was learning some of the things while the students were learning at the same time. I was trying to navigate myself through the curriculum and some things take longer, some things take a shorter time, or some take just enough time… This was a slow process, but then again some days things went fast and some days it went slow, depending on the concept and how much they were particular with that concept."

As this APES teacher alluded, teachers felt that too much material—and new student-centered PBL material, at that—was challenging for students.

Though in mid-spring treatment teachers reported using KIA curriculum on 82 percent of days in which they completed instruction logs, and all surveyed teachers reported on the end-of-year survey that they had used the KIA curriculum units throughout the year, some treatment teachers explained that project fatigue became an issue by later in the spring. As an example of project fatigue interfering with full implementation, an APGOV teacher described circumstances that are fairly common in AP classrooms in general toward the end of the school year (e.g. "senioritis"),

> "Toward the end I had to just more lecture because I felt like in the beginning our

> students were a lot more engaged in the project. I felt like they were getting a lot more out of it. And then I think it just became, I wouldn't even say difficult for our students. I just think that they weren't used to the work load… A lot of the students were confused at the end and I think the big issue was a lot of them weren't willing to put in the work. What I noticed in the very beginning, I thought it was really effective… But there was an issue where senioritis kicked in, that combined with the fact that we have a very small class, and it just became very ineffective and almost impossible to do [KIA]. So somewhere along, right after the Supreme Court unit, so we did our cases and then kind of from there on out – which coincided based on [our school's] schedule – I kind of just lectured."

While this was not always the experience of KIA teachers, and may have been a function of implementing KIA in different types of schedules (i.e. traditional versus block versus modified block), some students also felt the pacing was too fast or that their KIA class "demanded so much work to do in such limited time." This sentiment emerged from five of the ten group interviews with treatment students, as well as a handful of individual student interviews at the end of the year. As one student said, "[If] we could just review it once in a while and break things down, like slow the pace just a little bit and it would be a little bit better." Students also described projects feeling tedious because there were too many. In the following excerpt, one APES student in a group interview described project fatigue in his/her own words:

> "The work wasn't all that bad, but I felt like there was so much of it in a certain amount of time. It was just thrown at us. Let's say we would have a couple pages and then we would have a whole project we had to do. Then after that project, the next day, we had another project. And we just didn't really have time to relax or cover some other type of topics and just go over things. It was just like one after another after another."

In an APGOV group interview, another student expressed a similar feeling including desire for balance between projects and more traditional, direct transmission modes of instruction that are helpful for reflecting and retaining information.

> "Projects were more fun than sitting and watching someone, but I feel like there needs to be a better balance between just sitting and watching someone lecture and projects. I think it needs to be almost 50/50 because you'd be able to retain the information more. Like the projects were fun, it was just too much, too many, and not enough time."

Pacing was very challenging for both teachers and students. As one student summarized in a group interview, "the ideas of the projects are good it's just some of us – or maybe all of us – just need to, like, pause just a moment just to, like, breathe in because of all the stress and anxiety." The solution, adapting the curriculum through cutting and combining tasks and lessons, was one of teachers' most frequent adaptations.

Perceived benefits of KIA for students

Our end-of-year interview protocols for both treatment teachers and students included a general question asking stakeholders to reflect on how they believe KIA affected them and/or their students. The most prominent theme to emerge from their responses related to deeper student learning, discussed in the first part of this section. Other common responses from KIA teachers and students

referenced students' increased awareness of civic and environmental issues. Students also felt prepared for the AP examinations despite reporting less frequent explicit AP test-preparation activities.

Deeper learning through KIA

Though there are a number of ways to think about what 'deeper learning' means, we used the Hewlett Foundation's conceptualization to guide our understanding of the construct for qualitative coding and analysis purposes. According to the Hewlett Foundation's definition of deeper learning (Hewlett Foundation, 2010), through instruction intended to support deeper learning, students:

- Learn how to learn,
- Master core academic content,
- Work collaboratively,
- Think critically and solve complex problems, and
- Communicate effectively.

By the end of the year as compared to the beginning, a greater proportion of interviewed treatment teachers discussed deeper and better learning as an advantage of PBL in general. When asked specifically about how KIA affected students, most treatment teachers brought up at least one of the listed components/sub-constructs of deeper learning, most frequently mentioning learning how to learn, content mastery, and collaboration. A coach reflecting on his/her own prior KIA students, made a remark that more holistically tied all elements of deeper learning to KIA:

> "I think my students have more transferrable skills in terms of those success skills, communicating, working in groups, problem solving, thinking critically. I think they have a more lasting understanding of what environmental science is as a result of the course. It has a lot of pros."

Treatment teachers perceived improvements in students' ability to learn

Among the five Hewlett aspects of deeper learning, teachers' perception that through KIA, students learned how to learn was the most pronounced. Approximately half of the KIA teachers interviewed talked about students' growing persistence, responsibility for their own learning, accountability to others, research and discussion skills, note-taking skills, etc. They also referenced students' newfound appreciation of the necessity for daily effort, attendance, and not procrastinating to produce high-quality work. One treatment teacher explained more fully how one instructional element of KIA – opportunities to iteratively submit drafts/components of work products – helped students to develop their understanding of high-quality work, accountability for producing high-quality work, and time management:

> "KIA really pushed them to do high-quality work; even if they missed out on maybe a high-quality grade at the beginning, the work was ongoing: they were able to do redesigns and kind of bounce back from maybe something that wasn't high-quality… I'd hand something back and say, 'You haven't met the requirement yet. You need to continue to do this, you need to do these things to meet the high expectation.' I think not allowing them to settle for mediocre work or work that they just did in an hour and turned in – I think that helped in the long run; seeing that they're going to be held accountable for their time management and work that they're doing in the classroom."

Students as well as teachers referenced students' development of time management, efficiency, and organizational skills. As an example, in one group interview, one student commented that learning to manage time can help to deal with "stress and anxiety" associated with juggling a heavy academic workload. However, students' feeling that they had to teach themselves content and skills and expressed wish for more guidance from their teachers (as described above on pp. 13) suggests that the KIA curriculum and/or KIA teachers' instructional practices could make learning to learn goals more explicit.

Students in treatment classrooms focused on mastery of core academic content as a KIA benefit

However, whereas more teachers than students reflected on the process of "learning how to learn," more treatment students referred succinctly to their mastery of core academic content as the benefit of KIA. Increased subject area knowledge was one of the most common benefits of KIA that students perceived. Treatment students in a majority of group interviews and about one-third of individual interviews described increasing their subject knowledge and interest through their APGOV or APES class. Students described becoming more interested in the subject field, more informed and knowledgeable about the subject, and more interested in future study in the subject area.

APGOV students in particular described being more informed about how the U.S. governmental and political systems work. A treatment student compared the broad relevance of APGOV for all students since, "every two years there's going to be an election, so you've got to be prepared for that," to that of AP Calculus, relevant only to those students who "go into engineering or something like that." As another student described, many students experienced KIA as a more hands-on, authentic way to learn, which involved students and helped them understand the content more so than the standard transmission approach.

> "I take a couple of AP classes and I think this is one of the easier ones for me to understand and grasp more, because I am a hands-on learner. All the other ones, it's kind of like you sit in a class and you take notes, and then you don't understand those notes, and then you fail the test and so on. I think this class made us more involved in what we were learning, so it was easier to grasp, I guess."

Approximately one-quarter of treatment teachers also discussed how KIA students gained more understanding of the course content through doing projects, and how they started to apply their learning to their own lives.

Students in treatment classrooms also practiced communication and collaboration skills

Students also referenced another aspect of deeper learning, gaining experience working with peers and honing collaboration skills, as a benefit of KIA. One-third of interviewed KIA students and participants in nearly two-thirds of the student group interviews talked about group work having an effect on them besides being enjoyable. Working with their peers helped them to learn, and also helped them to practice their communication and collaboration skills. These results relate to students' and teachers' more general perspectives on group work.

Treatment teachers viewed ample opportunities for authenticity as a KIA strength

One of the intended features of the KIA approach is that students' learning opportunities should be authentic. Project-based learning can be authentic in several ways; students can find content and

skills relevant to their lives, share products of their learning (e.g. a piece of written work or a presentation) with people outside of the classroom, and practice using "tools" that people use outside of the classrooms, like letters to the editor or government representatives, memos, podcasts, and films (Polman, 2015).

Compared to control teachers and students, at the end of the year, treatment teachers and students both reported more frequent "authentic" learning opportunities, such as sharing their work with outside audiences, (by 2.3 SDs and 0.23 SDs, respectively). Interviewed treatment teachers felt that the KIA curriculum's greatest strength was ample opportunities to make it authentic, though teachers needed to adapt to make it so.

Though teachers had to work at teaching the KIA curriculum in a way that was authentic for their particular students in their own environments, they viewed KIA authenticity as an implementation facilitator. In end-of-year interviews, most treatment teachers referenced the real-world relevance of the curriculum to students' lives (i.e., one of the Polman, 2015 features of authenticity) as a positive feature and none referenced it as a challenge. In contrast, control teachers only talked about planning authentic learning experiences as challenges. Treatment teachers described KIA tasks as *allowing for* authenticity:

> "With [the KIA] curriculum, it allows you to draw in those things and encourages students to think about things that are going on in the real world and help make those connections."

One teacher described how decisions about how to implement the curriculum in an authentic way coincided with how their students used the curriculum in their own lives:

> "Campaigning, the role playing – I decided that based on the curriculum I invited a lawyer to come into the classroom, I invited a retired AP government teacher to come in and speak to them, and they're all – they're very politically active themselves, you know, in what they're learning through the curriculum. They're applying – their clubs and their groups some of the kids are involved with – some of the kids were involved in the campaigning, knowing question to, and they're asking me questions – questions about politics so they're very civically engaged."

The preceding excerpt reveals some of the congruency in two of the KIA curriculum's strengths: authenticity and opportunities to develop students' civic skills and engagement. Teachers discussed authenticity and civic focus similarly; the KIA curriculum's strengths lie in the opportunities to make students' learning processes authentic *and* civically-oriented. By the end of the year, treatment teachers' comments about the benefits of PBL emphasized the relatedness of authenticity/relevance and engagement. One teacher reflected,

> "The advantage is that from my perspective as well as a student perspective they can relate to what they are – they can relate the things that they're learning from the text to what they actually see or happening in the environment as a whole. The traditional approach would be – sometimes it can be very abstract and it's hard to relate to abstract things. When you get a chance to do the stuff in the project-based activity or learning

then it does make a whole lot of sense. You can put things into perspective. You can see the meaning and the purpose of it."

At the end of the year a KIA student also related authenticity to engagement, albeit using the words "cool and interesting" in place of engagement:

> "I thought [the KIA approach] was really effective, especially in government, because [our teacher was] preparing us to work in the government and be policy advisors and all of that, and they don't really do tests and stuff, so our projects were mainly based on real things that you might have to do as a policy advisor. I thought that was really cool and interesting."

At the same time, half of the treatment teachers interviewed acknowledged that, without adaptation, the curriculum could be outdated or inappropriate for some contexts/places. One APES teacher shared,

> "If anything, it would be cool to tailor some of the projects to a more urban environment. I think that a lot of the projects were, like, the Farm project and it was based in Iowa. It was – I mean, the Oceans in Action was in the Pacific Northwest. I think it was hard for my students to think about themselves and their lives being a part of some of the projects. My recommendation would be to try and tailor it to a – just kind of a more urban environment so that my kids can see themselves living in the projects as opposed to having them envision themselves in somewhere where they never see themselves."

Through KIA, teachers are tasked with tailoring projects and civic engagement elements to be as robust and authentic as possible, enabling students to see their own lives in their work.

Students in treatment classrooms perceived civic engagement and environmental activism benefits

In response to the end-of-year interview question about how KIA affected them, almost one-third of treatment students and one treatment teacher talked about their increased knowledge (i.e. deeper learning) effectually raising their awareness of real-life political and environmental issues. In addition, on the end-of-year survey, treatment teachers reported emphasizing development of students' knowledge necessary to engage civically (e.g. voting, petitioning, campaigning for a political candidate, community planning, conservation, environmental advocacy) more so than control, by 0.8 SDs.

Civic engagement was an expected benefit that we explored in more depth with treatment students, in regards to raised awareness of current political and environmental issues, activism, and applied learning. In response to questions to students about how they benefited from KIA, what from KIA they could take into the future, and what effect KIA might have on their civic engagement, they spoke first-hand to the impact they perceived on their future behaviors and intentions related to civic engagement and activism.

As important context, the 2016-17 school year wrapped around the historic November 2016 presidential election, in which Donald Trump won more electoral votes than Hilary Clinton to win the presidency. For many reasons, this election and aftermath was unlike any other in modern U.S. history, and certainly provided atypical salience and relevance for APGOV students' civic engagement-related

responses.

KIA APGOV students referenced civic engagement in terms of voting, citizen behaviors, rights, and political viewpoints. In contrast, when APGOV control students spoke about civic engagement—rather than talking about understanding why to vote and how students can enact their power by making their voices heard, as treatment students did—they referenced understanding of civil liberties and rights, becoming better people, and knowing how to be an involved citizen.

The majority of APGOV treatment students' civic engagement-related comments, discussed predominantly in the student group interviews, referenced increased likelihood of voting because of a newfound awareness of why to vote. Students talked about wanting to vote more themselves, as well as trying to explain more to other people about the importance of voting. For example, one student said:

> "This class definitely made me want to vote more. If young people voted more, then politicians would put more focus on the things that young people would be interested in. I might as well do my part."

Another student explained,

> "A lot of people that I talked to that said they don't vote because they think that their vote doesn't count, and I'm trying to explain to them how it works and how it does…it helps a lot more to make an argument of why you should do it."

APGOV students also described their course as helping them to understand that individuals have the power to affect the political system. A student shared his/her newfound understanding that, "one person can make a difference" and another described wanting to "work on campaigns or contact local government in my area to see if I can become a little more active." This student described learning about the power of the individual in U.S. government in his/her KIA class, "I guess I just didn't realize that I actually do play an important role in what happens in my government." In another group interview, an APGOV treatment student similarly shared a newfound understanding that students "have to have our voice,"

> "If we don't speak up and show what we want then they're not going to change anything. This year I've gone to more marches and been more active in my government, wanting to have things change."

When APES students in treatment group interviews discussed civic engagement, they spoke about becoming more resourceful and cutting down on resources use, as well as encouraging others to care about the environment. APES students in both the treatment and control groups referenced adopting conservation behaviors driven by increased awareness of how human actions affect the environment. Students talked about changes they were already trying to make in their own lives, as well as changes they planned to make in the future. For example, reflecting on the Eco-Footprint activity, one student said:

> "I did see a significant change. I did cut down on certain things I use, like with water, with oil and all of that. I cut down a lot."

Other students acknowledged that they are not at the point in their lives where they are making consumer decisions in their household, but they talked about making changes in the future. Students

talked about decisions regarding electricity use, automotive pollution, grocery shopping, etc. One student said,

> "For me, I actually don't mind riding a bike, probably ten miles if I have to, but when I actually have to go places I'll consider buying an electric car rather than the gasoline cars we have today. I feel like we need to move more efficiently and cleaner rather than having coal mines and oil drilling and all these things that are really, really harmful to the environment."

Another student expressed a similar sentiment about making future decisions in the grocery story,

> "Right now, obviously I'm not of age to go live on my own, and my parents handle the whole shopping things. But when I am on my own, I feel like when I'm in a grocery store I'm going to second-guess what I'm buying and be like, 'Do I go for the cheaper, more harmful to the environment one, or do I go for the little more expensive, but it was naturally made and stuff like that?' I feel like I'll be weighing decisions to see what's best."

Students in treatment classrooms felt prepared for the AP examinations

In the fall, interviewed treatment students described expecting to feel prepared for the APGOV or APES examinations the following May. During end-of-year interviews, after students had taken the exams, most treatment students continued to describe themselves as prepared. As context, on the end-of-year survey, compared to control, treatment students reported somewhat less frequent AP exam preparation between September and the end of March (-0.18 SDs), though essentially the same frequency of AP exam preparation in April and May (-0.08 SDs).

Treatment students had various opinions regarding whether they were more prepared for the multiple choice versus the free response subsections of the exams; some said that FRQ questions were more difficult because they did not cover parts of the topics in class, while others said the multiple-choice items were more difficult because of the terminology and vocabulary they needed to memorize.

In response to questions about what helped them to feel prepared, most interviewed treatment students said the AP practice tests, study guides, and test-taking strategies provided by their teachers were the most helpful. In interviews, many KIA students described the value of "learning for the test" in the days and weeks closest to the AP exam date. Some students reported working on practice tests throughout the school year, such as this student:

> "Two or three weeks prior to the exam, my teacher gave out these past/released AP tests and we took it as a test grade. And those really helped prepare me for the AP exam, because a couple past years, some teachers didn't really prepare me, and they didn't really expose us to the AP material content, like the test style and that environment… I wasn't able to prepare myself that well, but this year, because of the tests that she gave us at two weeks, like, constantly—like, every class, we took a multiple-choice part or like an FRQ, like, every other class. That really helped prepare me for what the test was testing on and questions that are pretty similar sometimes, so that really helped."

The second-most frequently referenced activity that helped prepare KIA students for the AP examination was the KIA projects. Even when they said the review and practice tests were the most

helpful, some students also acknowledged that that information was woven into the projects and labs they did throughout the year. For example, one student explained that their review and "drilling" was not the same as learning new information right before the exam:

> "I thought [KIA] prepared us fairly well. In the last month and a half, we started more learning for the test, but it wasn't new information. And throughout the year, we were reading chapters from a textbook, and the information on the test was pretty straightforward. There wasn't a lot of room for interpretation. But yes, I think we were pretty well prepared. He drilled us on some specific topics that he knew were going be on the test, like court cases, for instance. We did a lot of court cases work, but also those were woven into projects, too, so I guess that was pretty helpful for that, also."

The same student also felt the purpose of his/her APGOV class was, "less preparing us for the AP test but more preparing us to be politicians and go out into the politics world."

One treatment teacher reflected on how students felt about the AP exam, and described how the KIA instruction approach and student engagement contributed to their preparation. He/she described how "taking an active role in what they're learning" helped students remember the information so that after the examination they understood the purpose of what they had done building up to that point. The teacher said students' comments were, "Now I get it. Now it all fits together. I feel like I was really prepared for the test."

Treatment teachers felt KIA is aligned to the relevant AP curriculum frameworks and exams, though exam preparation remained a common concern

At the end of the 2016-17 school year, there were no differences between treatment and control teachers in reports of the extent to which the curriculum they had used was aligned to the AP curriculum frameworks and AP examinations (0.01 and 0.09 SDs, respectively). Treatment teachers also reported more alignment between their curriculum and Common Core State Standards for English Language Arts and Mathematics and the Next Generation Science Standards than did control teachers, with differences ranging from approximately 1 to 2.5 SDs.

However, despite reporting that the KIA curriculum largely aligned well with the exam, at the end of the year, one-third of interviewed treatment teachers talked about how preparing students for the AP exam was a challenge. Being vigilant about covering everything for the exam was one of teachers' biggest concerns, as the following two excerpts from teachers illustrate:

> "I had to be really purposeful in the planning of making a connection between AP test and project-based learning. Like I'm preparing you for this AP test at the end where you have to know all this content, and in project-based learning we might not be learning every single piece of content that you're going to have to know. I had to be purposeful in making sure that we went back and covered, when necessary, some of the bigger issues."

Covering everything expected to be on the AP exam was a common concern, even when teachers felt like the curriculum was well aligned. In addition to planning connections between the AP test and KIA projects, another strategy teachers described was double-checking that KIA students were retaining the "factual material" (e.g., vocabulary and concepts) they would need to know for the exam.

One teacher explained,

> "My consistent challenge was: are the students learning what they need to learn, like the factual material? We were doing the stuff, and they were producing things, and they were enjoying it, and I was enjoying the experience of it. There was always this running inner monologue of, 'Okay, that's really cool and that's great, but at the end of the day, do they know what divided government means?' … there were times where we got to the end of it, and they didn't know – and I realized well okay, that's where I've got to go back and figure out how they make that – how to make that happen. That was my big challenge, is just making sure that within the project cycles, checking to make sure that they're getting that foundational base knowledge that they have to come out with because of the AP exam. If it weren't for the AP exam it wouldn't matter, because they were getting valuable learning experiences through the projects. But because of the AP exam, [there's certain] vocabulary they have to know, there's certain things they have to know, and just making sure that that kind of stuff is getting covered sufficiently."

Such concern or doubt may have driven the extra preparations and AP materials (e.g., practice tests) that teachers provided for students as the examination date drew closer.

In both classrooms of the teachers previously quoted, students in the end-of-year group interviews talked about the AP exam being easier than they expected. One student even said, "I feel like the exam was a lot easier than any test we've ever taken in this class." They felt very prepared by the resources their teachers provided (e.g., study guides, practice tests), and their teachers helped them identify where units would most likely be covered more heavily than others on the exam, but the key was that, as one group interview participant stated, "We were actually reviewing. In a lot of classes your review is you [learning] stuff new."

Perceived benefits of KIA for teachers

Through KIA, teachers' understanding of PBL deepened, expanding their instructional repertoire. Treatment teachers' perceptions of KIA were positive, and almost all plan to continue using KIA and recommend it to others. School leaders, though less familiar with the KIA approach and resources, also supported KIA use.

KIA improved teachers' understanding of PBL, expanding and deepening their tools

As expected, by the end of the year, treatment teachers' understanding of PBL had clarified and deepened. For example, a teacher described better understanding the role of driving questions as, "open-ended, the kids really have to really create and do versus find these answers." Another teacher described a radical shift in understanding of how to provide feedback over the first two projects,

> "Understanding how important peer feedback is in PBL and how helpful that can be in the classroom; that really kind of changed the way I did things in the classroom. Because before it was like, 'I've got to look at all this stuff, I've got to get feedback on it all the time.' At the beginning – the first two projects –students assess their own work and give meaningful feedback and respond to each other and kind of have more opportunity to like see other arguments, see other concepts in action and then give feedback to each other. That was really kind of an eye-opening experience.

In response to an interview question about how KIA affected them as teachers—including their AP course, teaching, professional growth, and themselves—some treatment teachers responded by pointing out how KIA has challenged them to develop *their own* critical thinking and apply it to their teaching. As one APGOV teacher stated,

> "It was beneficial because it does pull us out of our comfort zone and put us at another level to be more resourceful, to be more critical thinker, to be more analytical, to actually not just regurgitate, not only for the student to regurgitate the material, but they were also required to apply what they were learning. For me that was beneficial being able to apply the knowledge to real world experiences or real-world situations for that matter."

Another APGOV teacher described how working through KIA over the course of the whole year was helped him/her understand how to implement the "true heart of project-based learning."

> "I'm grateful for the opportunity to be able to see what project-based learning looks like through a curriculum that was developed by somebody else. Because creating your own project-based curriculum with all of this stuff that's out there, you never really know if you're getting to the true heart of project-based learning, or if you're just handing out what everybody calls 'dessert projects,' just a big piece at the end. Being able to work through an entire curriculum has been really helpful ... And knowing all of the different components like voice and choice…knowing all of those different elements that need to be implemented and the fact that they need to build on each other and kids need to be responsible for doing, not just sitting and learning. That's been the best thing this year, just being able to work through somebody else's curriculum."

The most prominent perceived benefit for treatment teachers was a new lens on curriculum and instruction and the new set of "tools" for their "toolbox." While KIA was challenging for teachers and had both perceived advantages and disadvantages, most KIA teachers' big-picture takeaway was that KIA helped make their teaching more authentic and engaging for students, with students driving their own learning. One APGOV teacher said, "I definitely think [KIA] helps me think more about how to engage students because I think one of the best parts of this [year] was the fact that students are so engaged with the projects." Speaking specifically about the tools and options KIA provided, another APGOV teacher said,

> "The positive was – like a different way of thinking about the course, I think we get – as teachers settled into little grooves and it gave me a whole new set of options and tools to draw on, and even just comments the coaches – the coach would make would be, hey, I could utilize this activity or this approach in this class, even in something simple as like seating kids in a different way to encourage group participation. It definitely gave me more tools in my bag to use."

KIA inspired teachers to start thinking about teaching, and approaching their classes, with more emphasis on student centeredness. As described by the following excerpt from an interview with a KIA teacher, KIA gives experienced teachers "fresh eyes:"

> "[KIA] made me really start to think not just about the AP course, but my other courses

as well. I'm department chair, I'm PLC Lead, so I could take these ideas to my team and start to see my team starting to slowly incorporate some of these things. It made me step back and look with fresh eyes at some stuff that I'd been doing for a long time, to say, 'I can apply the PBL criteria and perhaps make this better.' Or if something that wasn't working and I didn't understand why it wasn't working [I would say], 'Well let me look at this through the PBL lens and see how we can apply some things,' and, 'If they know they're going to have to publicize this work, suddenly they care a lot more about how it comes out.' I keep the two little [PBL gold-standard souvenirs] they gave us right by my computer so that when I'm planning and thinking of things, it's always there like, 'Why is this not working? Oh, let's incorporate student voice. Okay, let's do that. Oh, let's take it beyond the classroom, let's do that.' [KIA is] incorporating itself into all of my classes, at least in little bits and pieces."

Many KIA teachers, including the previously quoted teacher and the following APES teacher, also expressed the intention of using PBL more in their teaching moving forward. For these teachers, KIA demonstrated the connection between curricular authenticity and student engagement – and that made an impact on them.

"I think like I'm going to look for PBL either units or curriculum in anything I teach from here on out… I think putting content that would normally be presented in a lecture or a PowerPoint or in a textbook reading – taking that kind of content and putting it in a real-world context makes the learning more engaging, more real-world, and provides students with purpose to understanding it. Which my struggle now with chemistry is sometimes that is completely missing: like we are covering content and skills because it is something that they need to know if they go on in chemistry. I think I've tried to do this with environmental science obviously because it lends itself to real-world problems, and I think this curriculum does a really good job with that, but I think this is really emphasizing how important it is to make what you do in the classroom real-world and make it engaging for students."

Even veteran teachers who have taught AP for a number of years, or who have been professional development trainers for other teachers, found that they learned and benefited from KIA. When asked how KIA affected her/him, an APES teacher said:

"I've been teaching for 10 years and so it's hard to find professional development where I feel like I'm learning a lot of stuff, and I feel like I learned a lot of new stuff this year just in how to organize something like this. I'd like to see my physics classes slowly start adopting and doing more of a project-based learning as opposed to how we've been doing it and I feel like I've learned a lot."

Treatment teachers' perceptions of KIA were positive, including that almost all plan to continue using KIA and recommend it to others

In alignment with their holistically positive sense of the benefits of KIA for themselves as teachers, at the end of the year, all but one of the KIA teachers in our survey analytic sample (96 percent) reported that they plan to use elements of KIA in their non-APES or APGOV courses. All but two (93 percent) would encourage non-AP teachers to use elements of the KIA approach to curriculum and instruction

in their courses and plan to use KIA the next time they teach APGOV or APES. And 89 percent would encourage their school to adopt KIA curriculum for all AP classes.

Interview results conveyed the same message; when asked if they would recommend KIA to other teachers, most treatment teachers said they would. As a treatment teacher explained, KIA "intrigued" other teachers and students,

> "[KIA] definitely intrigued lots of people in the social studies department… But it's definitely intrigued, especially some of the ones that teach older students, like the 11th and 12th graders.... It's definitely intrigued a lot of them discussing what project-based learning is and how they can put it in their classrooms."

Another teacher gave their strong endorsement of KIA,

> "I would absolutely recommend it, I have been recommending it to people, and if they want to know more about it, I'm happy to sit down and talk to them about, 'Oh, here's what true PBL looks like. Here are some things you can do, and here's part of what makes it PBL versus just let's do projects.'

During end-of-year interviews, the majority of treatment teachers also described incorporating KIA practices into other courses to a limited extent, with a smaller proportion describing more radical changes to their other courses. Reasons for using KIA in other courses included other students hearing about activities and wanting to take part, and teachers wanting to engage students. Limiting factors to incorporating PBL into other classes included students not being ready for PBL, the preparation time necessary, and the KIA approach not working well with particular (non-APGOV or APES) course content. An APGOV teacher explained the challenges of using the KIA approach in his/her world history class, including that, "that's just not part of the curriculum… I couldn't see myself doing it successfully… the students in world history are not advanced students so it's a little bit more difficult for them to do the higher-level tasks… their behavior is different, their attention span is different, so I wasn't able to implement some of that. And in some ways, it really doesn't work for world history." However, this teacher did share being, "able to successfully do some debates with them."

School leaders' perceptions of KIA were positive, though they were less familiar with the approach

Finally, we turn to school leaders. Through end-of-year surveys and interviews, most school leaders reported recommending KIA to other schools and teachers, though with the caveat that most were also unfamiliar with the KIA approach and resources. Among the 12 school leaders that responded to the end-of-year survey, eight encouraged the AP teachers in their school to follow the KIA curriculum during the 2016-17 school year; two did not and two others were uncertain, using the "do not know" response option. Eight school leaders also affirmed (i.e., agreed or strongly agreed) that they would encourage all AP teachers to use elements of the KIA approach; four were uncertain, though none dissented. However, these school leaders did not see the KIA approach as quite as generalizable to non-AP teachers, with four of 12 affirming that they would recommend non-AP teachers to use elements of KIA; two would not and six were uncertain.

One school leader exemplified the position that they would recommend KIA to others despite not really knowing it well:

> "Do I feel confident and can go out there and pitch it to teachers? No. But, just the fundamental ground that it stands on for me is part of my belief of good teaching in terms of project-based learning."

However, another school leader recommended KIA because of perceived benefits for the teacher,

> "I think the effect has been very positive. I've actually seen its impact extend beyond the AP classes. I've seen [the KIA teacher] really move towards project-based learning in all of his classes. Something that I've been speaking to him about, and really a push I am trying to give him, is to have him share that practice with other colleagues as well, sort of spread this practice throughout the history department or even throughout the entire high school team. It seems that is going to be the big push for next year."

Conclusion

Though a large body of observational research suggests that teachers can and do use PBL curricular and instructional approaches in a variety of settings, none have harnessed an RCT approach to determine the impact of a PBL intervention on classroom practice in an AP setting (e.g. Condliffe et al, 2017). This study demonstrated that KIA's curriculum and supports resulted in pedagogical shifts, moving AP teachers in the direction of greater emphasis on deeper learning objectives, more student-centered instruction and use of performance assessments, more authenticity, and less lecture and explicit examination-preparation. Treatment students and teachers reported perceived benefits for students in the areas of deeper learning, civic engagement, and AP examination preparation. Treatment teachers described maturing proficiency implementing complex instructional practices.

The study also illustrates the challenges of the instructional shifts. Both teachers and students found the transition difficult in the areas of students' comfort with responsibility for driving their own learning—a new experience for many students—and pacing. Teachers also found facilitation of group work on projects difficult to facilitate. The AP context is particularly challenging because of the sheer amount of content covered in the course-specific AP curriculum frameworks and the looming end-of-year, high-stakes examination. Given the unique AP contextual demands on top of the challenge of shifting from a transmission to PBL approach in any context, the observed, sustained shift in KIA teachers' AP practice in virtually all critical aspects of instruction was not assured.

Treatment teachers' beliefs about the alignment of KIA to the AP curriculum framework and examinations, and students' feelings of learning more deeply and being prepared for the AP examinations—despite reporting less frequent lecture and explicit AP test-preparation activities throughout most of the school year—are of particular importance to scaling and sustaining KIA as an approach for teaching AP. Treatment teachers' remarkably positive perceptions of KIA, including close to unanimous plans to continue using KIA and recommendations of KIA to others, will also be critical to scaling and sustaining the approach.

Other reports and articles will examine the impact of KIA on teachers' curricular and instructional approaches after teachers have two years of KIA experience, as well as the causal impact of KIA on student outcomes after teachers have one and two years of KIA experience.

Endnotes

[i] Latinx students disproportionately compose a higher proportion of AP Spanish Language, Spanish Literature, and Italian Language and Culture courses and are underrepresented in all other AP courses (Kolluri, 2018).

[ii] Passing is officially defined as scoring three or above on a five-point scale, though postsecondary institutions vary in their criteria for awarding college credit. Though the percentages of students that scored three or higher on at least one exam increased, from 12 percent in 2003 to 23 percent in 2017 (College Board 2014; College Board, 2018), in conjunction with the overall decrease in pass rates, these statistics suggest that the majority of passing exams are achieved by a subgroup of students who are also each taking a disproportionately high number of AP exams.

[iii] In the few cases in which more than one teacher from within a given school provided a survey response at the end of the school year, we examined those teachers' responses to see if their answers matched. When they did not match, we selected one of the teachers' responses to use to represent that school. We used the following decision rules: if teachers selected "I don't know" to one or more relevant items, we selected the teacher with fewer "I don't know" responses; when one teachers' responses included missing data (e.g., they skipped items or questions) we selected the teacher with more complete responses; in the rare instance that teachers provided different responses to school context questions we randomly selected one teachers' response to use. We implemented these decision rules separately for each school context item set.

[iv] We have teacher gender for all 74 participating teachers. For every other characteristic we provide the number of teachers on whom the descriptive statistic is based.

[v] We limited the analytic sample to include only teachers who completed both the pre- and post-survey so that we interpreted changes/shifts among the same teachers.

[vi] Due to the recruitment and randomization timeline, we were unable to administer the teacher survey prior to treatment assignment; teachers knew their treatment status when they filled in their pre-survey. Treatment and control teachers' pre-survey responses tended not to demonstrate baseline equivalence, meaning either a) treatment and control teachers were different from one another before KIA, or b) the pre-survey responses were biased by knowledge of treatment assignment. We know that teachers were equivalent on their students' prior year (i.e. May 2016) average AP scores and assume that randomization resulted in equivalence on unmeasured characteristics as well. If teachers were equivalent on unmeasured and measured characteristics, the baseline differences suggest that teachers' knowledge of their treatment status affected their results. The possibility that knowledge of treatment status biased results suggests that post-survey results may also be biased. To mitigate potential teacher self-report bias, we triangulate teacher reports with data collected from students and coaches.

[vii] We excluded logs completed more than 48 hours after the day of instruction. Most teachers had zero or one late log, and two teachers had more than three late completions. Of 615 logs completed by teachers in the analytic sample, 577 were completed on time and included in analyses. Number of logs completed per teacher ranged from one per teacher (n=two teachers) to 13.

[viii] The instruction log instrument asked teachers, "To what extent was your lesson on this day in your [AP US Government/AP Environmental Science class] intended to focus on the following student learning objectives?" Response options included, "not at all, to a limited extent, to a moderate extent, to a great extent." We did not provide elaboration on most listed objectives, though we provided examples for "develop interpersonal skills (e.g. collaboration, leadership, communication skills)," "develop intrapersonal skills (e.g. resilience, curiosity, reflection, self-directed learning)," and "develop civic engagement (e.g. explicit development of skills, knowledge, and/or attitudes that students could apply to civic participation.)"

[ix] In the instruction log, examples of ongoing project or assignment work included: revising written work, researching a specific topic, completing project tasks. Examples of quick turnaround assignment work included: study or complete a vocabulary list, textbook reading, practice free response questions.

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Appendix A: Summary and timing of data collection approaches

Data Collection Approach	Timing
Teacher pre-interview	August 2016
Teacher pre-survey	August 2017
Student pre-interview	October/November 2016
PD staff and coach post-first semester interviews	January 2017
Teacher instructional logs	March/April 2017
Teacher post-interview	May 2017
Teacher post-survey	May 2017
Student individual post-interview	May 2017
Student post-survey	May 2017
Student group post-interview	May 2017
School leader post-interview	May 2017
School leader post-survey	May 2017
PD staff and coach post-interview	July 2017
Online curriculum portal 2016-17 usage data	July 2017
Collection of PD and coaching documents	2016-17

Appendix B: Instruction Log Instrument

KIA_Teacher_Logs_RCT

Q1 Choose the date for which you are completing this instruction log
(for example, if you are completing this log for yesterday's class, enter yesterday's date):

Q2 Please select one answer below:

- ○ I provided instruction in ${e://Field/selected_course_period} on this day. (1)
- ○ I did not provide instruction in ${e://Field/selected_course_period} on this day. (2)

Display This Question:

If Q2 = 2

Q3 Why did you not provide instruction in your targeted class on this day?

- ○ I was attending professional development (1)
- ○ Students were participating in standardized testing (2)
- ○ Students were on a field trip or at another special event (3)
- ○ Personal reasons (e.g., sick, family emergency, etc.) (4)
- ○ This was not one of our scheduled meeting days (6)
- ○ Other, please describe in the box below: (5) _____

Display This Question:

If Q3 = 6

Q4 You have indicated that this was not one of your scheduled meeting days with your ${e://Field/selected_course_period} class, the section that is participating in the KIA Study.

<u>This log will not be counted</u> as one of your 10 completed logs. Please only complete logs on days that are PLANNED meeting days.

End of Block: All

Start of Block: yes provided instruction

Q5 In this day's class (${Q1/ChoiceTextEntryValue}), did you...

	Yes (1)	No (2)
Co-teach with another teacher? (1)	○	○
Support a visiting individual who provided instruction to your students (e.g., community member, academic or practical expert, college or career representative, etc.)? (2)	○	○

Q6 Please indicate the number of ...

○ Students who were present in the classroom for at least half of the instructional period (1) _____

○ Total scheduled minutes for class period (2) _____

Q7

Answer the remaining questions thinking generally about the students who were present in this class period (${Q1/ChoiceTextEntryValue}).

Q8 How much total time (in minutes) did students on average spend actively engaged with course-related learning? In other words, do not include time spent on non-instructional activities such as administrative tasks, fire drills, etc.
(Write in number of minutes. Enter 0 if students did not spend any time actively engaged with learning.)

_____

Q9 How much total time (in minutes) did students on average spend using technology related to the curriculum or instruction during this day's period of instruction? Example uses of technology include anything related to the use of a computer or computerized device as well as working independently on a computer-based curriculum.
(Write in number of minutes. Enter 0 if no time was spent using technology related to the curriculum or instruction.)

_____

Q10 To what extent was your lesson on this day (${Q1/ChoiceTextEntryValue}) intended to focus on the following student learning

objectives?

	Not at all (1)	To a limited extent (2)	To a moderate extent (3)	To a great extent (4)
Develop content knowledge (Q3.14_1)	○	○	○	○
Develop AP exam-taking skills (Q3.14_2)	○	○	○	○
Develop critical thinking skills (Q3.14_3)	○	○	○	○
assigned_course = APES				
Develop scientific literacy skills (Q3.14_4)	○	○	○	○
Develop engagement/motivation (Q3.14_5)	○	○	○	○
Develop interpersonal skills (e.g., collaboration, leadership, communication skills) (Q3.14_6)	○	○	○	○
Develop intrapersonal skills (e.g., resilience, curiosity, reflection, self-directed learning) (Q3.14_7)	○	○	○	○
Develop college or career awareness (Q3.14_8)	○	○	○	○
Develop problem-solving skills (Q3.14_9)	○	○	○	○
Develop creativity (Q3.14_10)	○	○	○	○
Develop civic engagement (i.e., explicit development of skills, knowledge, and/or attitudes that students could apply to civic participation) (Q3.14_11)	○	○	○	○

Q11 To what extent did your instruction on this day (${Q1/ChoiceTextEntryValue}) include the following activities?

	Not at all (1)	To a limited extent (2)	To a moderate extent (3)	To a great extent (4)
Teacher lectured to the entire class (Q3.10_1)	○	○	○	○
Close reading of text or other materials (Q3.10_2)	○	○	○	○
Teacher modeled skills for students (Q3.10_3)	○	○	○	○
Individual or student teams presented material to the whole class (Q3.10_4)	○	○	○	○
Independent student work (Q3.10_5)	○	○	○	○
Team/group work (Q3.10_6)	○	○	○	○
Whole group instruction (Q3.10_7)	○	○	○	○
One-on-one instruction from the teacher or another member of the instructional staff (Q3.10_8)	○	○	○	○
Assessments to determine mastery of specific material (Q3.10_9)	○	○	○	○
Assessments that had a purpose other than determining mastery (e.g., state standardized tests) (Q3.10_10)	○	○	○	○
Culminating project presentation (Q3.10_11)	○	○	○	○
Activities that include applications to the world outside the classroom (Q3.10_12)	○	○	○	○
Simulations, debates, structured academic controversies, or mock trials (Q3.10_13)	○	○	○	○

Q12 To what extent was instruction characterized by the following on this day (${Q1/ChoiceTextEntryValue})?

	Not at all (1)	Some of the time (2)	Most of the time (3)
Students were grouped with students who were roughly matched in competency levels (1)	○	○	○
Students were grouped with students at varying competency levels (2)	○	○	○
Instruction or content was personalized based on student interest (3)	○	○	○
Instruction or content was personalized based on academic need (4)	○	○	○

Q13 In this period of instruction...

	Yes (1)	No (2)
Did students engage in short term project work (i.e., the project spans roughly one day)? (1)	○	○
Did students engage in long term project work (i.e., the project spans more than one day)? (2)	○	○
Did you assign work for the majority of students to complete outside of class? (3)	○	○

Display This Question:

If Q13 = 3 [1]

Q14 Which best describes the take-home assignment?

○ Ongoing project or assignment work (e.g., revising written work, researching a specific topic, completing project tasks) (1)

○ Quick turnaround assignment (e.g., study or complete a vocabulary list, textbook reading, practice free response questions) (2)

Q15 Did any of the following factors influence your decisions about what and how to teach this class on this day

(${Q1/ChoiceTextEntryValue})?

	Yes (1)	No (2)
The need to prepare students for the AP exam (Q3.19_1)	○	○
The need to prepare students for a district or state assessment (Q3.19_2)	○	○
Students' personal learning goals (Q3.19_3)	○	○
Students' ideas about what they wanted to work on (Q3.19_4)	○	○
Input from the student's family (Q3.19_5)	○	○
Data from formative assessments (e.g., quick checks for understanding, quizzes) (Q3.19_6)	○	○
Data from summative assessments (e.g., end of unit written assessments, performances of understanding) (Q3.19_7)	○	○
Data from practice AP assessments (e.g., quiz banks, practice writing assignments (Q3.19_8)	○	○

Q16 Did you use any of the following resources to help you prepare for this particular lesson?

	Yes (1)	No (2)
Non-KIA curriculum (2)	○	○
KIA curriculum (1)	○	○
Specific curriculum/instructional guidance from district (e.g., pacing guide) (7)	○	○
Ideas or materials from a KIA professional development session (9)	○	○
Ideas or materials from a non-KIA professional development session (4)	○	○
Ideas or materials from a non-KIA coaching session (5)	○	○
Ideas or materials from a Buck Institute for Education (BIE) coaching session (8)	○	○
Lesson plans you created and used in previous years (11)	○	○
Ideas or materials provided by a teacher/peer who is not participating in KIA (14)	○	○
Ideas or materials provided by a teacher/peer who is participating in KIA (16)	○	○
Ideas or materials from a KIA online community (17)	○	○
Ideas or materials from an online community **other than** KIA's online community (18)	○	○
AP curriculum frameworks (19)	○	○
Common Core State Standards (12)	○	○
assigned_course = APES		
The Next Generation Science Standards (13)	○	○

[i] Officially defined as scoring three or above on a five-point scale, though postsecondary institutions vary in their criteria for awarding college credit. Though the percentages of students that scored three or higher on at least one exam increased, from 12 percent in 2003 to 23 percent in 2017 (College Board 2014; College Board, 2018b), in conjunction with the overall decrease in pass rates, these statistics suggest that the majority of passing exams are achieved by a subgroup of students who are also each taking a disproportionately high number of AP exams.

[ii] In the few cases in which more than one teacher from within a given school provided a survey response at the end of the school year, we examined those teachers' responses to see if their answers matched. When they did not match, we selected one of the teachers' responses to use to represent that school. We used the following decision rules: if teachers selected "I don't know" to one or more relevant items, we selected the teacher with fewer "I don't know" responses; when one teachers' responses included missing data (e.g., they skipped items or questions) we selected the teacher with more complete responses; in the rare instance that teachers provided different responses to school context questions we randomly selected one teachers' response to use. We implemented these decision rules separately for each school context item set.

[iii] We have teacher gender for all 74 participating teachers. For every other characteristic we provide the number of teachers on whom the descriptive statistic is based.

[iv] We limited the analytic sample to include only teachers who completed both the pre- and post-survey so that we interpreted changes/shifts among the same teachers.

[v] Due to the recruitment and randomization timeline, we were unable to administer the teacher survey prior to treatment assignment; teachers knew their treatment status when they filled in their pre-survey. Treatment and control teachers' pre-survey responses tended not to demonstrate baseline equivalence, meaning either a) treatment and control teachers were different from one another before KIA, or b) the pre-survey responses were biased by knowledge of treatment assignment. We know that teachers were equivalent on their students' prior year (i.e. May 2016) average AP scores and assume that randomization resulted in equivalence on unmeasured characteristics as well. If teachers were equivalent on unmeasured and measured characteristics, the baseline differences suggest that teachers' knowledge of their treatment status affected their results. The possibility that knowledge of treatment status biased results suggests that post-survey results may also be biased. To mitigate potential teacher self-report bias, we triangulate teacher reports with data collected from students and coaches.

[vi] We excluded logs completed more than 48 hours after the day of instruction. Most teachers had zero or one late log, and two teachers had more than three late completions. Of 615 logs completed by teachers in the analytic sample, 577 were completed on time and included in analyses. Number of logs completed per teacher ranged from one per teacher (n=two teachers) to 13.

[vii] The instruction log instrument asked teachers, "To what extent was your lesson <u>on this day</u> in your [AP US Government/AP Environmental Science class] intended to focus on the following student learning objectives?" Response options included, "not at all, to a limited extent, to a moderate extent, to a great extent." We did not provide elaboration on most listed objectives, though we provided examples for "develop interpersonal skills (e.g. collaboration, leadership, communication skills)," "develop intrapersonal skills (e.g. resilience, curiosity, reflection, self-directed learning)," and "develop civic engagement (e.g. explicit development of skills, knowledge, and/or attitudes that students could apply to civic participation.)"

[viii] In the instruction log, we provided the following examples of ongoing project or assignment work: revising written work, researching a specific topic, completing project tasks. We provided the following examples of quick turnaround assignment work: study or complete a vocabulary list, textbook reading, practice free response questions.